ENVIRONMENTAL PLANNING FOR MINE CLEANUP AND DEMOLITION ACTIVITIES

Brian W. Buck, JBR Environmental Consultants, Inc., Salt Lake City, UT
Matthew P. Zietlow, Homestake Mine, Lead, SD

ABSTRACT

Environmental planning for final cleanup and demolition of mining facilities is a critical step in the overall reclamation of these sites. Identification and proper handling of a myriad of waste streams is important to complete before demolition of facilities commences. Additionally, issues such as utilities, soil and water pollution control, historic concerns, and permitting considerations must all receive careful consideration prior to demolition contractors mobilizing onsite. These decisions can affect the schedule and cost of the demolition activities because they may control how the demolition contractor will conduct his activities. Surveys should be completed to identify special building materials that may need to be abated prior to demolition such as asbestos and lead-based paint. Potentially recyclable materials should be identified and characterized to assess the owner's liability if these materials are recycled including: scrap steel, processing equipment, brick, and wood. Major demolition waste streams also need to be characterized for disposal in on-site or off-site landfills. Finally, all these characterization and environmental planning decisions should be documented in facility records, and written guidance on these matters should be prepared for the demolition contractor before he finalizes his bid for the work. The authors demonstrate how all this was done to plan for the demolition of the mill and numerous support facilities at the renowned Homestake Mine in Lead, South Dakota.

PROJECT SETTING AND DESCRIPTION

The Homestake Mine is located within the northern Black Hills in the town of Lead, South Dakota. During its 125-year life (1876 - 2001), mining was conducted both above and below ground, ultimately reaching a total depth of over 8000 feet. Mineral processing at the mine occurred at several sites, and included various methods such as gravity separation, mercury amalgamation, Merrill-Crowe zinc precipitation, carbon adsorption, and cyanide extraction. Recent surface facilities at the Homestake Mine were comprised of several dozen structures, including the main mill, two large sand plants, thickeners, lab facilities, and various mechanical and administration buildings. Many of these were constructed over the sites of older process buildings dating back to the late 1800's.

The Homestake Mine announced its shutdown in September of 2000, and in December of 2001 the last ore was mined. Final processing and gold recovery efforts continued until early the following year, and demolition of the first surface facilities was initiated in June of 2002. A total of 40 million ounces of gold were produced during the life of the Homestake Mine, of which over 60,000 ounces were recovered during the 2001 - 2002 cleanup and closure efforts alone. Another item of note occurred in December of 2001, when Barrick Gold Corporation merged with Homestake Mining Company, creating the third-largest gold mining company in the world. Reclamation and closure plans did not significantly change, as both companies are at the forefront of responsible mine operation and reclamation. Homestake Mining now operates as a wholly-owned subsidiary of Barrick Gold Corp.

ESTABLISHING CRITICAL PATHWAYS FOR THE PROJECT

Identifying critical pathways and anticipating "bottlenecks" was imperative in the planning of the surface facility demolition. Several noteworthy areas considered early in the planning phase are summarized below:

- Overall Project Schedule: The initial project involved the demolition of 28 surface structures down to their foundations. In order to have this completed in a region with a relatively short construction seasons, it was imperative that defined timelines were developed, followed, and met. Key personnel were selected for implementing and tracking all tasks. Bidding and contractor selection was accomplished as efficiently as possible to get these personnel involved in planning as well.
- Personnel: A primary goal was to retain and use existing employees wherever possible. This often involved moving employees from their existing roles into new environments particular to the mine shutdown, typically requiring some retraining. The benefit in keeping these individuals rather than hiring outside contract labor was in the retention of their institutional knowledge of the facility.
- Interfacing with Operations: Final gold recovery efforts were still ongoing in the early months of 2002, sometimes creating difficult planning scenarios for the demolition team. Remaining personnel were often charged with multiple responsibilities significantly different than those they were accustomed to while the mine was operating, at times mandating additional training.
- Interfacing with Community: Potential conflicts with city utilities such as power, water, street closure/utilization, noise, air quality, and general traffic patterns were identified and mitigated.
- Material Disposition: Safety, environmental, and cost concerns all were key factors in determining ultimate material disposition. Detailed inspections and procedures were developed for each facility to identify materials of concern. An on-site landfill was specifically permitted for this project to accept all demolition materials other than those shipped out for recycling or those identified as hazardous waste.
- Permits & Notifications: The age of many of the structures mandated historical consideration. Other necessary permitting and notifications had to also be planned for, such as asbestos abatement and RCRA-related sampling and follow-up. Permits requiring public notice periods were identified and submitted early enough to not hinder the schedule.
- Manpower & Equipment: With the work force being reduced weekly, the demolition prepatory work had to be carefully orchestrated in order to not create labor shortages. Other mines within the company were also beginning to salvage equipment for their own use, creating the need to identify and tag critical spares for remaining operations.
- Site Utilities: Electricity, gas, water, sewer, and compressed air all had to be considered. Additionally, many city utility lines ran through or beneath the existing project site. Determining where and when they could be disconnected without impacting remaining work efforts or the community was critical. If re-routing were necessary, routes, which could be utilized, that wouldn't interfere with demolition efforts were implemented.

- Weather: The Black Hills area generates extreme weather patterns, including heavy snows, rains, wind, and hail. Time contingencies allowing for weather delays had to be considered in planning all activities related to the demolition project.

REGULATORY AND POLITICAL CONCERNS

Homestake insured community concerns were identified and addressed throughout the project, and assigned an individual specifically to the task of community affairs relative to the mine closure. Both social and economic concerns were expected, not only from layoffs associated with the mine closure, but also changing attitudes associated with the end of a mine, which was integral to the community for over 125 years. Prior to demolition, alternate uses for buildings slated for removal were considered, as well as traffic impacts, parking, noise, dust, and overall aesthetics. Community meetings were held to allow local residents to voice any concerns over the upcoming project, and a specific "Complaint Hot-Line" was initiated for phone calls. Tours were also conducted daily through the local visitor's center.

Agency contacts were initiated early to provide ample time for agency input. In a small community such as Lead and in sparsely populated states such as South Dakota, regulators are often more accessible to the general public than in more urban regions. Regular communications as to project progress and planning were necessary to keep these agencies from feeling uninformed or unable to answer constituent's questions. Weekly meetings were also conducted to involve interfacing with local law enforcement and emergency services.

A number of general regulatory hurdles were identified early in the project-planning phase, specifically those related to:

- Identification and characterization of waste streams that would or might be produced during demolition;
- Management of demolition wastes in compliance with applicable State and Federal requirements; and
- Determination of applicability of regulations for certain beneficiation and mineral processing materials.

The demolition project was also critically reviewed to identify other waste streams that were likely to be produced during the demolition work. These included:

- Containers of chemical products, lubricants, reagents, and maintenance materials;
- Electrical equipment with possible PCBs or mercury content;
- Asbestos containing materials;
- Wood or steel coated with lead paint;
- Tanks, piping, sumps, and other equipment containing mill slurry or reagents;
- Scale, sludge, rock and other beneficiation-related materials under tanks and floors;
- Recyclable material such as scrap metals, equipment, and possibly wood from old structures and wood tanks;
- Petroleum contaminated soil or concrete from past spills;
- Wood treated with creosote and other preservatives;
- Common demolition debris;
- General trash or other municipal solid waste, and;
- Stormwater runoff from the site.

Once the potential waste streams from the decommissioning and demolition project were identified, specific management strategies were developed for each waste stream. These management plans addressed the practical aspects of how, when, and where the materials would likely be produced; if they were recyclable materials or wastes; the economic aspects and comparisons related to any management options; and how the materials were regulated by local, State, and Federal requirements.

All the demolition waste streams were objectively reviewed with regard to how they were regulated under State and Federal hazardous waste rules. A number of exemptions from these rules were identified for certain waste streams, these were found to include:

- Scrap metal that was recycled [40 CFR 261.6(a)(3)],
- Mill sludge, scale, and other beneficiation or processing material that was recycled for gold recovery [40 CFR 261(a)(16) and 261.6(a)(2)],
- Lamp bulbs, batteries, and thermostats that were removed and handled as universal wastes [40 CFR 261.9],
- Mill equipment or debris that was in contact with beneficiation slurries, reagents, and solutions [40 CFR 261.4(b)(7)],
- Wood that is arsenical treated [40 CFR 261.4(b)(9)],
- Wood that is recycled for further use [40 CFR 261.2(e)(1)] and
- Used oil that is recycled [40 CFR 261.6(a)(4)].

These exemptions were incorporated into the planning of the materials management for each of the demolition waste streams. Use of these exemptions was also documented in the planning records.

PRE-DEMOLITION ACTIVITIES

Safety and environmental track records were considered paramount in selecting a demolition contractor for this project. Because of the mine's location within the city limits, the utmost precautions had to be taken to insure the safety and welfare of not only the public, but also the remaining workforce and the environment. Numerous walk-throughs and screening interviews were conducted with prospective bidders to insure all issues were clearly identified, including the difficult topography and adjacent surface water bodies. Bidders were asked to provide templates of various documents such as Health & Safety Plans, Stormwater Plans, and methods for spill prevention, noise, and dust control. The successful bidder was required to submit acceptable final plans before commencing work.

Utilizing institutional knowledge from long-term employees along with historical documents, operating plans, and records, areas with pipelines and tanks long-since taken out of service were identified, inspected, drained, and rinsed as necessary. Personnel were assigned to catalog and file historical drawings and records to allow for retrieval in future years.
Air and noise monitoring, including asbestos, were conducted in the work area and nearby community to establish a database of background levels prior to demolition commencement. Monitoring records from previous years were also used when appropriate. As the demolition preparatory work progressed, field surveys and inspections of buildings was ongoing to insure an up-to-date record was available for the different waste streams that would be generated.

Examples of these waste streams are described below:

- <u>Containers:</u> Inspections and inventories were made of tanks and containers of petroleum products, reagents, maintenance materials, and all other containerized material that would need to be emptied or removed from within the battery limits of the demolition project before demolition would begin. The description of these tanks and containers, along with their contents, was entered into the planning records. Where a tank or container held a material that could not be readily identified, a sample was taken for characterization.

- Lead Paint: A survey was made for the presence of lead paint on all like-painted surfaces throughout the facilities and buildings to be demolished. The survey was conducted with a portable x-ray fluorescence (XRF) instrument. A report on the survey was prepared for incorporation into the planning records and to be transmitted to the demolition contractor for their use in complying with applicable OSHA regulations. Follow-up sampling was then conducted on specific areas based on the XRF study to determine RCRA status.
- Asbestos: A comprehensive asbestos survey had been conducted throughout the facilities in previous years. This information was copied into the project records and also provided to the demolition contractor who would be responsible for abatement of the asbestos as part of demolition activities. The asbestos consultant that completed the initial inventory was rehired to provide quality control inspections for Homestake during the abatement activities.
- Gold & Other Metals: The mill staff conducted sampling of certain mill equipment (scale and sludge), sumps, and floors along with the refinery floors and walls to characterize any mercury and gold contents of these materials. Material found to have sufficient metal content to be valuable was removed with hand tools and power equipment for recycling back to the mill circuit for recovery. Residual slurries and other process solids throughout the mill area were also picked up and recycled to the mill. The timing of this decommissioning activity was critical because certain parts of the operations had to be taken out of service for this metal recovery operation to occur while parts of the mill circuit were still operating. Records of this recovery process were kept including the chemistry and amounts of materials recycled.
- Electrical Equipment: As buildings and facilities were taken out of service, a mill maintenance crew inspected them for the presence of electrical equipment that might contain PCBs and/or mercury. This was especially important within certain motor control centers and control panels that had not been previously inspected because they were energized. Records of these inspections were kept for the project records. At this same time, lights, batteries and thermostats that could be managed as universal wastes were also removed.
- PCBs: A previous survey of transformers, switches and other large electrical equipment had been conducted to identify PCBs. This information was copied to the project records and used to identify potential areas where past spills may have contaminated floors or ground under electrical equipment that previously contained PCBs. As the equipment was de-energized and removed, surveys were conducted of specific sites to determine if there was PCB-contaminated concrete or earth that needed to be removed.
- Demolition Debris: Field surveys were conducted of the buildings to be demolished to describe each building or facility as a potential separate demolition debris waste stream. Approximate volume percentages of each major building component (walls, frame, roof, doors, etc.) were made for each building. Also, using the previous lead paint survey results, representative samples were taken of the different building components and composited to make a representative composite sample of the potential demolition debris for the entire building. Each of these composite samples was then analyzed for

hazardous waste characteristics. The sampling records, composite sample designs, and analytical results were entered into the project records.

- Concrete and Soil: A survey of the general mill site was conducted to identify potential locations of past spills of reagents, mercury, petroleum, mill slurries, and solutions where concrete surfaces or soil may have been contaminated. Once these sites were identified, grab samples of the concrete or soil were taken. Concrete cores were obtained from 22 locations and sampled in four intervals within the top 2.5 inches. Soil samples were taken with a Geoprobe under the concrete in some locations and outside of the buildings in other locations. Samples of concrete and soil were assayed for the RCRA metals (arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver), total extractable petroleum hydrocarbons, and PCBs. A report was prepared by the consultant who did the work reporting and interpreting the results.

To assist with legal and regulatory documentation for the project, and to provide clear guidance to the demolition contractor and Homestake field personnel who would be involved with the demolition, a comprehensive Demolition Project Environmental Guidance Document was prepared for the project. This document assembled in one place the important environmental compliance information that was specifically applicable to the project. The information contained in this report is best shown by the table of contents for the report that is reproduced in Table 1.

A very important part of the Environmental Guidance Document is Section 5 that includes detailed descriptions of the designated management procedures for each of the main waste streams that were expected to be produced during the project. Each of the major waste streams had a narrative description of what materials were included in the waste stream, its physical characteristics, how it is regulated by State or Federal rules or site-specific permits, and specific handling procedures for the material. This part of the guidance manual was reviewed by legal counsel to make sure that the legal and regulatory aspects of the planning were correct and properly described.

The completed Environmental Guidance Manual was appended to the project specifications for use by the demolition contractor during the project, and was also included as an attachment to the contract itself. The Manual included requirements for verification and documentation that all applicable plans were being followed.

The final disposition of the major waste streams was determined through the environmental planning efforts. Interaction with the demolition contractor on feasibility and costs for the management of the different materials provided the opportunity to consider recycling potential as well. The major waste streams were handled in the following ways:

- Containers of chemical products, lubricants, reagents, and maintenance materials were either transported to other mine facilities for direct use, transferred to Homestake employees for their use, picked up by the original vendor for restocking, or disposed of in off-site facilities.
- All hazardous wastes were properly packaged for transportation and disposed of off-site in properly permitted hazardous waste management facilities.
- PCB containing electrical equipment was disposed off-site in a permitted facility.
- Mercury was recycled off-site.
- Asbestos containing materials were properly packaged and disposed of in a solid waste landfill permitted by the state to receive asbestos containing material.

- All wood was disposed of on-site in a lined, solid waste landfill that was specifically permitted and constructed for the demolition project.
- Steel tanks, structural steel, and other recyclable metal was visibly cleaned and transported off-site for recycling as scrap metal.
- Piping and other equipment containing residues or scale that could not readily be removed was disposed of on-site in the demolition project landfill.
- Petroleum contaminated soil was disposed off-site in a properly permitted municipal landfill or taken to a permitted land farm.
- Municipal-type trash such as paper, cardboard, and plastics were collected prior to building demolition and disposed of in local municipal landfills.
- Common demolition debris was disposed of on-site in the demolition project landfill.

Table 1. Table of Contents for Environmental Guidance Document

HOMESTAKE MINE
SURFACE FACILITIES DEMOLITION PROJECT
ENVIRONMENTAL GUIDANCE MANUAL

Table of Contents

5.4 Wood
5.5 Solid Waste
5.6 Petroleum
5.7 Chemicals/Chemical Products
5.8 Hazardous Wastes
5.9 Demolition Materials
5.10 Asbestos Containing Building Materials

6. Incident Guides
6.1 Process Solution Releases
6.2 Petroleum Releases
6.3 Chemical Releases
6.4 Storm Water Releases
6.5 Hazardous Waste Releases
6.6 Fires/Explosions

ACTIVE DECOMMISSIONING & DEMOLITION

Keeping multiple contractors and multiple tasks on schedule was paramount to successfully completing the project in one field season. Subcontractors involved in the asbestos abatement had to be carefully scheduled to complete buildings in an order conducive to the demolition contractor's schedule. The steep topography of the area mandated the demolition in an uphill manner, and working and storage space for equipment and salvage stockpiles was at a premium due to the proximity to homes, streets, and other structures. Maps were updated continuously to provide all personnel involved with up-to-date schematics for project scheduling and staging.

The contractor, along with company representatives, were involved with community meetings and "question and answer" sessions to familiarize the community with personnel, proposed methods of demolition, schedule, and expected traffic impacts. During the course of the project, several comments were actually received from community members commenting as to how little impact they actually observed. Employment opportunities for local citizens were also made available whenever possible. Typical jobs included hand laborers, water truck operators, and flagmen.

Adverse environmental impacts did not develop, as the contractor adhered to their spill prevention program as well as site-specific duties for such items as dust control and stormwater protection. Continuous environmental monitoring by both the company and the contractor around the project site confirmed these results and provided documentation for the project record. A Homestake environmental representative was at the project site full-time providing additional photographic and text records of the project progression.

The extensive investigative and inspection work completed in pre-demolition activities proved successful in that no significant new wastes were uncovered during actual demolition, and no environmental spills or accidents occurred. Waste streams and other materials were managed according to the plans as follows:

- Electrical Equipment: Light ballasts, motor control centers, transformers, switches, control instruments, and other electrical equipment were examined and, as necessary, sampled for the presence of PCBs and or mercury. Usable electrical equipment was sold. Mercury-containing instruments and switches were packaged and shipped off-site for retorting and recycling of the mercury. Non-salable electrical equipment that was free of fluids or hazardous materials was disposed of in the on-site demolition landfill.

- Gold-bearing Material: Scale, sludge and concrete surfaces with appreciable gold values were removed with hand and power tools from specific equipment, sumps and mill or refinery areas. All of this valuable material was recycled to the mill to recover the gold.
- Mill Equipment: Mill piping, pumps or other equipment that contained mill scale or sludge could not be easily cleaned out for recycling so this material was placed in the on-site demolition landfill. Tanks, crushers, mills, bins, launders and other mill circuit equipment that could easily be cleaned of sludge or scale were recycled off-site as scrap metal. Old wood tanks were examined and sampled for cyanide, arsenic, or other components of mill slurries that could be a concern. None of the concentrations were significantly elevated and the materials were placed in the demolition landfill.
- Building Structures: Structural steel and other recyclable metal that could be removed from the buildings during demolition was shipped off-site to be recycled as scrap metal. All other building materials were disposed of in the on-site demolition landfill. Concrete foundations were not included in the first phase of demolition and were left in place for further investigation and planning related to eventual demolition and regrading of the former building sites.
- Asbestos Containing Materials: The demolition contractor provided asbestos abatement services early in the project. Using existing asbestos inspection documents and current visual inspections by Homestake and the contractor, asbestos containing building materials were specifically identified at the site and removed by trained and licensed workers prior to building demolition. Homestake conducted continual quality control inspections of this abatement activity using the same asbestos consultant who conducted the original inspection project. All removed asbestos was properly encapsulated or otherwise packaged for transportation to an off-site asbestos disposal landfill.
- Containers: Homestake conducted thorough inspections throughout all buildings to identify and remove all containers of petroleum products, reagents, maintenance materials and other chemical products. These were identified, inventoried, sampled if necessary, and either disposed of or recycled off-site. All hazardous wastes were carefully characterized, packaged and shipped off-site for disposal in a permitted facility. Homestake and demolition contractor inspectors carefully reviewed each building for any remaining containers or accumulations of chemical products before each building was demolished to prevent such materials from being incorporated into the demolition debris.
- Universal Wastes: Homestake decommissioning crews, with assistance from the demolition contractor, carefully inspected all buildings and removed all lighting, batteries, and thermostats before demolition began and packaged these materials for handling primarily as universal wastes.
- Beneficiation/Mineral Processing Wastes: Considerable effort was made during decommissioning to remove scale, sludge and mill solutions from the mill circuit equipment and the building floors and sumps prior to demolition. These materials were either recycled to the mill before it shut down or were disposed of in the current tailings impoundment. Any of these materials that were encountered by the demolition contractor were disposed of in the on-site demolition landfill.

POST-MINE USE

There are many factors to consider when formulating post-mine use land planning, nearly all of which can impact a project schedule. It is imperative to not limit or restrict post-mine land use options through the decommissioning, demolition, and reclamation process.
The Homestake Mine has not yet determined a final use of the land involved with this portion of the mine closure project. However, areas such as aesthetics, business opportunity, tourism, community needs, historical perspectives, environmental issues, and public safety are all being considered to leave a positive, post-mining legacy.